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Sanitary Studies of Some Fresh Water Wetlands (Beels) of Sonitpur District, Assam

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Abstract: In the whole of the Sonitpur district there are 206 numbers of fresh water wetland covering an area of 3651.00 ha. Most of the wetlands in the region are unattended by conservation mechanism and are subjected to growth of unwanted biotic communities, inadequate population of plankton communities and dominance of mollusks at the benthic niche exerting pressure on native species and water quality deterioration. The present study aimed at sanitary evaluation of six freshwater wetlands (Beels) of Sonitpur District, Assam. The selected wetlands harbour a variety of aquatic flora and fauna and receive almost no municipal and industrial wastes. The studies were performed with 4 water samples in each fresh water wetlands in summer months (June to August) in 2007 and 2008. In water samples, total coliforms, faecal coliforms, faecal streptococci and pollution indicative index bacteria (TVC 20^0C, TVC 37^0C) were estimated as per standard APHA protocols. The analysis demonstrated that Batamari beel, Borchola beel, Bheselimora beel and Nalanidoba beel exhibited higher level of pollution than that shown by Barasara beel and Domkhoa beel. However, it was observed that none of the wetlands were strongly contaminated (class 5).

Keywords: Total coliforms . Faecal coliforms . Faecal streptococci . Total viable count . Beel.

1. Introduction

Wetlands are ecotones between terrestrial and aquatic systems [1], where the water table is usually at or near the surface or the land is covered by shallow water [2]. The most popular term used for the wetlands in Assam is the "Beels" [3]. The Beels of Assam are of two types viz. Lake-like beels and Ox-bow beels. Wetlands of Assam, estimated to be 101231.00 hectares, are important repositories of aquatic biodiversity. Sonitpur district is situated along the north bank of river Brahmaputra between the latitudes 26°31/N to 27°08/N and longitudes between 92°20/E to 93°47/E. The district covers an area of 5255.2 km^2. Total number of freshwater wetlands in Sonitpur district of Assam is 206 and it constitutes about 3651.00 hectares. The area has an average rainfall of 1900 mm, mainly between the months of May and September [4]. In view of the present large scale deforestation in the district [5] there is a great possibility of non point source pollution in the wet lands.

Monitoring to detect pathogens can be carried out without accompanying physical and chemical measurements and, therefore, can be very inexpensive [6]. Sewage, agricultural and urban run-off, and domestic wastewaters are widely discharged to water bodies. Pathogens associated with these discharges subsequently become distributed through the water body presenting a risk to downstream water users [7]. Counts of bacteria of faecal origin in rivers and lakes around the world which suffer little human impact vary from <1 to 3,000 organisms per 100 ml. However, water bodies in areas of high population density can have counts up to 10 million organisms per 100 ml [6]. So far no physico-chemical and

microbiological studies have been done as a whole lake basis in Sonitpur district's wet lands.

The present study aims at evaluation of water in six selected fresh water wetlands situated in Sonitpur district with respect to the presence of sanitary bacteria, including total coliforms (TC), faecal coliforms (FC), faecal streptococci (FS), index bacteria of water pollution like psychrophilic (TVC 20^0C) and mesophilic (TVC 37^0C) heterotrophic bacteria.

2. Materials and Methods

2.1 Study Area

The research was carried out on six fresh water wet lands in Sonitpur district of Assam as followed. Batamari beel (A) is situated at 26º38′39″N, 92º50′14″E covering an area of appx. 6 ha. Borchola beel (B), (26º35′27″N, 92º40′56″E) covers an area of appx. 60ha. Bheselimora beel (C), situated at 26º39′43″N, 92º44′19″E covers an area of approximately 200 ha.. Nalanidoba beel (D) , covering an area of approximately 10 ha is situated at 26º39′59″N, 92º32′57″E . Barasara beel (E), locating at 26º38′54″N, 92º40′58″E and Domkhoa beel (F), at 26º41′49″N, 93º2′46″E cover an area of approximately 230 ha and 65 ha respectively. Amongst all the beels under study, beel A and D are elongated and all other beels are compact in nature.

2.2 Sampling

The tests were performed in summer months, i.e. June to August of 2007 and 2008. Water samples from four randomly selected sites in each of the wet lands were collected at 15- 20 cm below water level, directly to sterile glass bottles with a ground cork which were transported in a 4^0C insulated container to the laboratory for analysis . Usually time between sampling and analysis was not more than 12 hours. Water temperatures were measured in situ with the help of a thermometer.

2.3 Microbiological Studies

The investigations comprised of determination of the following: total number (CFU/ 1 ml) of mesophilic bacteria on agar plate at 37^0C after 24 h incubation (TVC 37^0C), total number (CFU/ 1 ml) of psychrophilic bacteria on agar plate at 20^0C after 72 h incubation (TVC 20^0C), total number (MPN/ 100 ml) of total coliform (TC) bacteria, faecal coliforms (FC) number (MPN/ 100 ml) and the number (MPN/ 100 ml) of faecal streptococci (FC) .

Prior to the study, a series of 10 times dilutions of the sampled water were made. A sterile solution of physiological salt (0.85% NaCl) was used as diluting substance. The microbiological studies were performed according to standard procedures [8, 9].

Table 1 Analysis of bacteriological water quality originating from six fresh water wetlands (beels) using criteria given by Nahurska et al., 2004.

Water quality Criteria		Water Quality	% of studied samples*					
Parameters	Number of Bacteria	Classes	Beel A	Beel B	Beel C	Beel D	Beel E	Beel F
TVC 20^0C	<300	1	33.33	33.33	8.33	25	8.33	16.67
(CFU/ ml)	300- 5000	2	33.33	41.67	66.67	66.67	91.67	75
	5000- 10000	3	33.33	0	0	0	0	8.33
	10000- 1000000	4	0	25	25	8.33	0	0
	>1000000	5	0	0	0	0	0	0
TVC 37^0C	<200	1	16.67	8.33	0	25	25	33.33
(CFU/ ml)	200- 1000	2	50	58.33	41.67	25	50	41.67
	1000- 5000	3	33.33	33.33	58.33	50	25	25
	5000- 50000	4	0	0	0	0	0	0
	> 50000	5	0	0	0	0	0	0
Total Coliform	< 50	1	0	0	0	0	8.33	8.33
MPN/ 100 ml	50- 500	2	16.67	16.67	8.33	16.67	33.33	66.67
	500- 5000	3	50	50	50	58.33	58.33	25
	5000- 50000	4	33.33	33.33	42.67	25	0	0
	> 50000	5	0	0	0	0	0	0
Faecal	<20	1	8.33	8.33	25	16.67	25	33.33
coliform	20- 200	2	25	25	25	8.33	50	58.33
MPN/ 100 ml	200- 2000	3	50	25	0	41.67	25	8.33
	2000- 20000	4	16.66	41.66	50	33.33	0	0
	>20000	5	0	0	0	0	0	0

Water quality: 1- unpolluted, 2- insignificantly polluted, 3- distinctly polluted, 4- heavily polluted, 5- very heavily polluted, * total 16 samples in each beel in every study months.

3. Results and Discussion

Mean values of microbiological tests from four sampling sites obtained in each of the six analysed water bodies in individual months and years of sampling are presented in Figure 1 and 2. The water temperatures ranged during the study period were between 20^0C-23^0C.

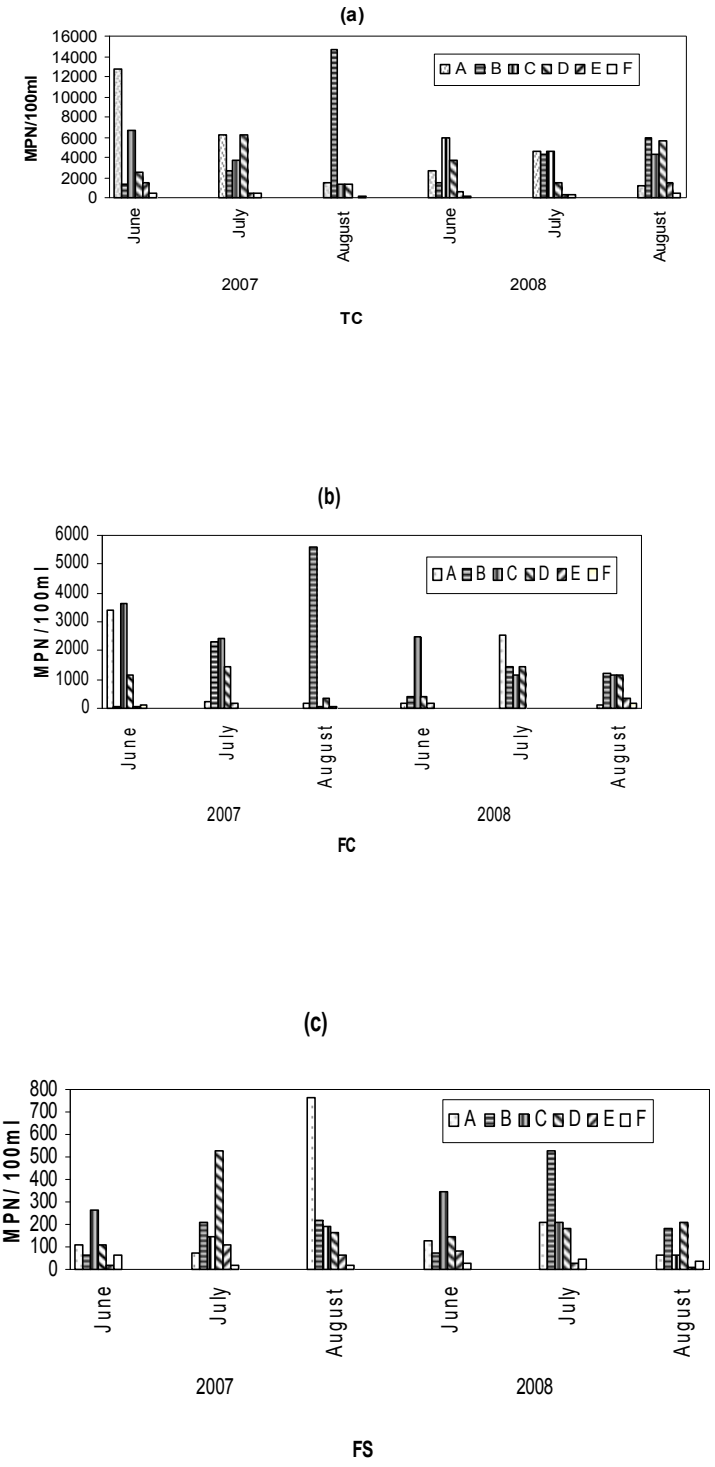

Fig. 1 Most probable number (MPN) of (a) total coliforms (TC), (b) faecal coliforms (FC), (c) faecal streptococci (FS) in water of Batamari beel (A) , Borchola beel (B) , Bheselimora beel (C), Nalanidoba beel (D), Barasara beel (E) and Domkhoa beel (F) during the years 2007 and 2008.

In analysis of the results obtained for the samples of Batamari Beel in the year 2007, the highest levels of TC , FC, Total Heterotrophic Counts (TVC 37^{0}C and TVC 20^{0}C) were detected in June and they amounted to MPN – 12,800/100 ml and MPN – 3410/ 100 ml, 1955 CFU/ ml and 4880 CFU/ ml respectively. The same study site experienced highest level of FS (MPN-760/ 100 ml) in the month of August. Whereas, during the year 2008, the highest values of TC (MPN- 4650/ 100ml), FC (MPN-2565/ 100 ml) , FS (MPN- 205/ 100 ml)and TVC 37^{0}C (CFU- 2310/ ml) , TVC 20^{0}C (CFU- 8350/ ml) were observed in the months of July and June respectively.

The Borchola beel, in the year 2007, showed highest MPN of TC (MPN- 14600/ 100 ml) and FC (MPN-5600/ 100 ml) in the month of August. Whereas, the highest number of FS (MPN- 220/100 ml) was observed in the month of August. TVC 37^{0}C (CFU-1285/ ml) and TVC 20^{0}C (CFU-17010/ml) were highest in the months of June and August respectively. On the other hand, the same beel experienced maximum TC (MPN- 6000/100ml) in the month of August and FC (MPN-1460/ 100 ml), FS (MPN-530/ 100 ml), TVC37^{0}C (CFU- 973/ ml) and TVC 200C (CFU- 5620/ml) in July , 2008.

The other study site, Bheselimora Beel experienced highest MPN of TC (6600/ 100 ml) , FC (3650/ 100 ml), FS (260/ 100 ml) and highest CFU of TVC at 37^{0}C (2030/ ml) in the month of June and TVC 20^{0}C (1685/ ml) in the month of July, 2007. Whereas, The maximum counts for TC (MPN- 6000/ 100 ml), FC (MPN- 2510/ 100 ml), FS (MPN- 350/ 100 ml), TVC at 37^{0}C (CFU- 2390/ ml) and TVC at 20^{0}C (CFU-13250/ ml) were observed in the month of June, 2008.

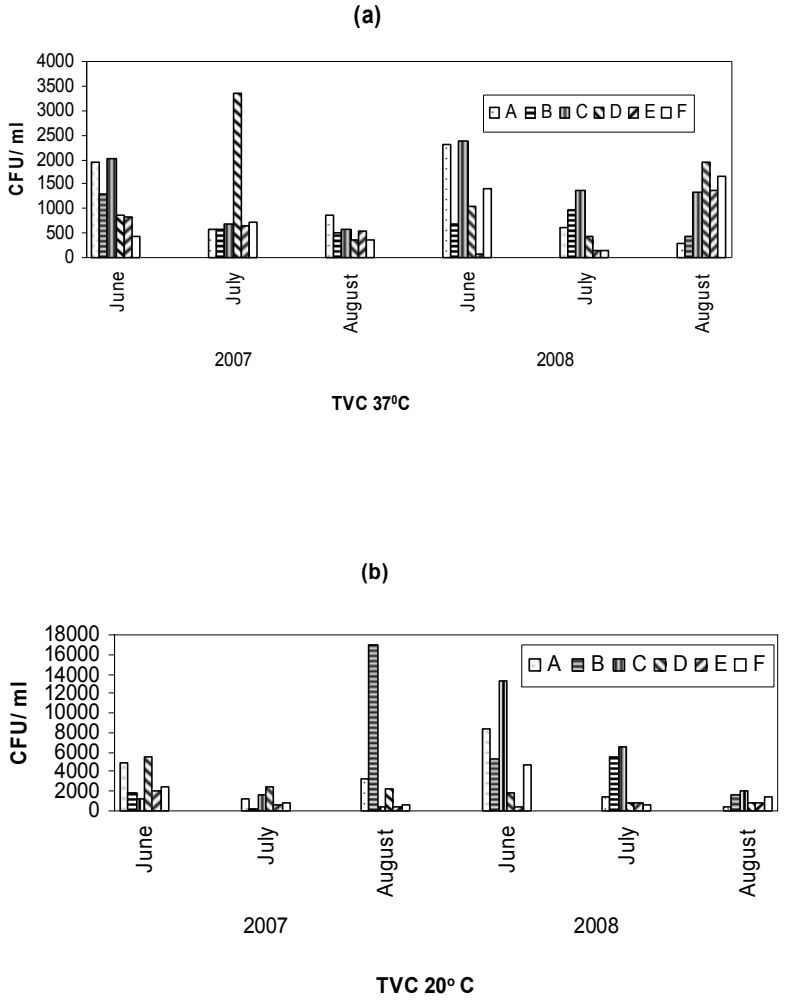

Fig. 2 Total viable count (TVC) (a) at 37^{0}C and (b) at 20^{0}C in water of Batamari beel (A) , Borchola beel (B) , Bheselimora beel (C), Nalanidoba beel (D), Barasara beel (E) and Domkhoa beel (F) during the years 2007 and 2008.

In analysis of results obtained from Nalanidoba Beel, highest numbers of TC (MPN-6200/ 100 ml), FC (MPN- 1460/ 100 ml), FS (MPN- 525/ 100 ml) and TVC 37^{0}C (3365/ml) were observed in the month of July' 2007. The highest Total Viable Count at 20^{0}C (5460/ ml) was observed in the month of June in the same year. Compared to this, the year 2008 experienced highest TC (MPN- 5600/ 100 ml) , FS (MPN- 210/ 100 ml) , and TVC 37^{0}C (CFU- 1945/ ml) in the month of August and that of FC (MPN- 1460/ 100 ml) and TVC 200C (CFU- 1831/ ml) in July and June respectively.

In comparison to the four above mentioned beels Borasora and Domkhoa beel showed lower levels of microbial counts. Borasora beel, in the year 2007, showed highest TC (MPN- 1460/ 100 ml) and TVC 20^{0}C (CFU- 2125/ ml) in the month of June and FC (MPN- 146/ 100 ml), FS (MPN- 110/ 100 ml), TVC 37^{0}C (CFU- 644/ ml) in the month of July. Whereas, highest numbers of TC (MPN-1460/ 100 ml), FC (MPN-321/ 100 ml), TVC 37^{0}C (CFU- 1380/ ml), TVC 20^{0}C (CFU- 915/ ml) and FS (MPN- 85/ ml) were observed in the month of August and June' 2008 respectively.

The Domkhoa beel experienced the highest numbers of TC (MPN- 425/ 100 ml), FC (MPN- 111/ 100 ml), FS (MPN- 60/ 100 ml) and TVC 20^{0}C (CFU- 2395/ ml) in the month of June and that of TVC 37^{0}C (CFU- 705/ ml) in July'2007. The same water container showed maximum counts of TC (MPN- 400/ 100 ml), FC (MPN- 146/ 100 ml), TVC 37^{0}C (CFU- 1655/ ml) and TVC 20^{0}C (CFU- 1434/ ml) and FS (MPN- 45/ 100 ml) in August and July respectively, in the year 2008.

In the evaluation of results of microbiological tests according to recommendations of Nahurska et al., 2004 (Table 1), it was observed that none of the wetlands were strongly contaminated (class 5). Batamari beel was found to be distinctly polluted when number of TVC 20^{0}C, TVC 37^{0}C, TC and FC were taken into account. Relatively few samples (16.66 % to 33.33 % samples) were classified as representing class 4, i.e. heavily polluted in case of observed FC and TC values respectively.

About 25 % and 33.33 % samples of Borchola beel was found to be heavily polluted with regard to TVC 20^{0}C and TVC 37^{0}C respectively. Heavy pollution with total coliform and faecal coliform were found to be in the range of 33.33 to 41.66 % in the lake.

On the other hand, 25 % and 58.33 % of samples of Bheselimora beel was found to be heavily polluted in terms of TVC 20^{0}C and TVC 37^{0}C, whereas total coliform and faecal coliform pollution was found to be about 42.67 and 50 % under class 4 category .

Regarding TVC 20^{0}C in Nalanidoba beel , 8.33 % of samples were found to be under class 4, whereas, 50 % of the samples were found to be distinctly polluted with TVC 37^{0}C. About 25 % and 33.33 % of the water samples of the lake were found to be heavily polluted with total coliform and faecal coliform.

Borasora beel and Domkhoa beel were the least affected in terms of microbial pollution. None of the wet lands were found to be heavily polluted in terms of TVC 20^{0}C, TVC 37^{0}C, TC and FC except in the case of total coliform which was found to be more than 50 % in samples of distinctly polluted Borasora beel only.

It should be noted that in the case of TVC 20^{0}C, upto 25% of samples of Borchola, Bheselomora and Nalanidoba beel were found to be heavily contaminated, whereas no samples of any beels were found to be heavily polluted in case of TVC 37^{0}C. In case of TC and FC, Batamari, Borchola, Bheselimora and Nalanidoba beels were found to be heavily polluted in the range of 16.66 % to 50% of samples.

A major difficulty in assessing the microbial quality of water the wet lands apart from the questions of sampling and culturing the organisms of interest, is the irregular nature of their abundances. Also, the microbial population's response to local environmental changes and its relation to accidental contamination cannot be revealed by periodic counts if these are too widely spaced. This is particularly true for fecal organisms, which can reach a water reservoir in totally unpredictable ways [10].

4. Conclusion

Amongst the six lotic water bodies investigated, Batamari beel, Borchola beel, Bheselimora beel and Nalani doba beel were found to be the most polluted followed by Barasara beel and Domkhoa beel. During summer, high water runoff and accelerated growth of microbes due to convenient temperature are responsible for higher degradation of organic matter, which eventually depleted the dissolved oxygen concentration, thus making some water bodies more polluted. The June and July batch samples showed highest amount of coliform organisms in the beel water which may be due to initial monsoon runoff directing towards the beels from the surrounding areas. However, the recent climate change for last five to six years have been changing the time of monsoon onset and duration in the region to a great extent which ultimately has also resulted in the change of seasonal bacterial population pattern in wet lands. Faecal contamination observed in the beels may be due to open defecation practices followed as well as cattle wastes in the neighbouring villages and agricultural fields eventually finding their way into the wet lands.

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